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Beyond The Mock Up: The Value of Temporary Occupancy and Evaluation

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When Children's Medical Center of Dallas (CMCD) was faced with the task of expanding its cardiology intensive care services, the perfect opportunity arose to step beyond the traditional patient room mock-up process and into interim occupancy and evaluation. CMCD is in the midst of master planning the future of its main campus; by responding to the immediate, intermediate, and long-term market demand, and a desire to craft a healing environment, CMCD created an opportunity to study a prototypical patient room over an extended time period. CMCD, working with HKS, Inc., built an interim 11-bed CICU suite adjacent to an existing 20-bed critical care service and will continue to evaluate the patient room prototype and associated refinements, which will then be employed in subsequent expansions. This article documents fundamental planning issues, both conceptual and detailed, in designing a CICU addition. It also addresses some of the design modifications imposed by existing conditions.

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Rationale for CICU and Clinical Needs

Population growth in the Dallas/Fort Worth area and an increasing market share of clinical services in North Texas led administrators at Children's Medical Center of Dallas (CMCD) to expand the pediatric hospital. In accordance with a master planning process designed to respond to short- and long-term market demands, and to achieve academic and clinical preeminence in pediatric medicine, several facility and programmatic needs were identified.

Among the first was the urgent requirement for additional intensive care beds, and, more specifically, cardiac intensive care unit (CICU) beds. Continuous occupancy rates in CMCD intensive care facilities near 100 percent resulted in frequent admission denials and elective surgery cancellations. Given the tertiary nature of services offered at CMCD, such refusal or delay of care constituted an abrogation of the clinical mission of the hospital and an impediment to the research program. Furthermore, the pressing need for specialization in pediatric cardiac intensive care to improve both physician education in this discipline and patient outcomes offered an opportunity for the development of a high-profile CICU program, which could bring recognition and prestige to CMCD and the affiliated UT Southwestern Medical School.

Initial facility expansion plans were therefore focused on the specific architectural and technological needs of the CICU population and the related programmatic effort. The planning and design team consisted of a broad range of clinical, design, technical, and administrative professionals and were additionally guided by data obtained by patient and family sampling. A further breakdown of the team included physician specialists, nursing representatives, medical equipment planners, facility managers and coordinators, information services personnel, executive level administrators, M/E/P engineers, architects, interior designers, and a construction manager.

The interim expansion project consisted of a two level, 13,000-DGS,F 11-bed addition to an existing 12,800-DGSF, 20-bed service. The patient beds and clinical support are located on the second level and the overflow staff support and family waiting area are directly above on the third level. The major goals and objectives for the addition included:
· Net increase of eight CICU beds (the building addition decommissioned 3 beds), creating an 11-bed addition
· Establish a sensitive healing environment for the pediatric patient, family, and caretaker alike

· Uniform patient room configuration (to the extent possible)
· Three functional zone (patient, clinician, and family) patient room prototype
· Flexibility within the patient zone
· Incorporation of the latest bedside technology available
· Observation capability
· Experimental patient room prototypes to potentially serve as design basis for non-cardiac critical care rooms in future construction in on- and-a-half to two years

This interim phase is serving as a prototype for a six-story expansion of the existing patient tower.

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CICU Suite Configuration

The CICU itself was designed as a pod off the main pediatric ICU. It incorporates an arena configuration with exteriorized rooms to maximize window space, entry of natural light, and nature views for patients, families, and staff. It also allows nurses and ancillary staff to circulate in an inner hallway.

Due to the existing footprint configuration and available exterior wall, a rectangular patient room module was created with the long axis running perpendicular to the corridor. Shorter travel distances between patients encourage a team approach to care and foster flexibility in caretaker response to patient needs or emergent situations. Wayfinding for families was also simplified by this layout, and large numeric signs clearly indicate room number and location.

Two specialized infection control patient rooms were created in the corners of the suite, each configured with anterooms. In one of the corners a protective environment room with positive pressure airflow was developed, and the other corner room was designated as airborne infection isolation requiring negative pressure airflow. The inclusion of these rooms facilitated immunocompromised (e.g., heart transplant) or potentially contagious children. A rooftop garden was added over half of the CICU to further enhance healing aspects of the environment.

Two central workstations were built into the interior core of the CICU. The first faces the CICU entrance and provides desk space for administrative/security personnel, networked computers for charting and medical data analysis, and desktop phones. Counter space was also made available for accessing and completing commonly used handwritten forms. The posterior part of the workstation houses a pneumatic tube delivery system, a printer, a fax machine, and multiple storage cabinets that close to avoid a cluttered appearance. The second workstation faces the back of the CICU and mimics the first in design.

Adequate floor space and chairs were provided behind both workstation desks to facilitate caretaker team meetings and discussion. By angling the glass entry doors to the rooms, the designers optimized lines of sight from the workstations into patient rooms. This also created recesses between pairs of rooms for decentralized, computerized substations from which patients could be visually monitored while caretakers chart or discuss patient issues. Since central monitoring has become less important as nurses spend more time at their patients' bedsides, these substations have improved nursing efficiency.

The frequent need to undertake surgical procedures at the bedside in the CICU population led to the placement of two surgical scrub sinks in the unit, one on each side, facing the adjoining hall. Additional features of the interior core of the CICU include a soiled utility room; a room for automated dispensing machine storage of cardiac-specific critical care equipment and medications; and storage alcoves for emergency equipment such as pharmacy carts and external pacemaker/defibrillators,

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which are easily accessible from all locations.

Equally important to the efficiency and quality of patient care was the core accommodation of radiology and continuous-recording ECG systems in a room with adjustable lighting. This room, which can be darkened to intensify projected images, permits display of computerized radiographs and 24-hour ECG recordings, which are accessed in real time by network connection. Such information can be rapidly incorporated into clinical management decisions, further manipulated for analysis, or stored for reference or research.

CICU Support Spaces

CICU support space requirements included a family waiting area to accommodate 44 patient relatives and their belongings, a family consultation room for private discussion, and associated desk space for security/hospital personnel. The waiting area is located directly above the CICU to facilitate wayfinding. Seating is arranged in alcoves off an open, central corridor to provide opportunity for communal as well as private interaction. Several chairs fully recline to allow for overnight stays. Window space with a view of the rooftop garden enhances relaxation and increases the amount of orienting natural light. Art depicts natural elements or unambiguously cheerful scenery to avoid negative interpretation. Phone and dataport access is available in each alcove. In addition, secure lockers are available for storage of belongings, and a small kitchen is present for food rewarming or coffee/drink preparation.

Office space for four physicians and six research coordinators/administrative assistants is present, as well as on-call rooms for four physicians, a staff lounge with locker and kitchen facilities, a secure research file room, and a room for electrical equipment. These latter spaces are accessible to hospital personnel only (via access badge) and are in close to the stairwell. A technologically sophisticated classroom complete with ports for medical gases, computers for clinical software training, and projection equipment for lectures and presentations supports the diverse educational missions of the program.

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Patient Room Layout and Equipment

As mentioned earlier, CICU patient rooms were designed to be as uniform in configuration as possible, incorporate or provide accommodation for the latest bedside technologies, and establish a healing environment sensitive to the needs of pediatric patient, family, and caretaker alike. Therefore, rooms were made larger than the typical PICU rooms at CMCD, and window space was maximized, limited only by code requirements. Furthermore, each rectangular room (oriented with its long axis perpendicular to the main hallways) and its associated equipment were organized into three interior zones.

The first zone, nearest the exterior window, is the family area where the patients' parents and visitors stay. In addition to the obvious exterior views and natural light extant in this location, facilities include adjustable fluorescent lighting, a desktop phone, a dataport for laptop computer connectivity, a wall-mounted television with VCR capability, and comfortable seating. One foldout sleeper chair was provided in each room to accommodate overnight sleeping/visitation by one parent.


View through patient room to family zone

The second, or middle, zone was designated the patient area. It includes the patients, their beds, and all other necessary medical equipment. Given the need to have access to a child's head in the event of an emergency, traditional headwalls, which restrict such access, were replaced with moveable, ceiling-mounted pendant-type booms. These dual arms, placed to either side of the bed, contain all medical gas and electrical outlets, as well as shelves and poles for ventilator equipment and IV infusion pumps.

Hydraulic brakes released by push button allow equipment to be rotated into innumerable configurations and subsequently remain in place. Moreover, flexibility of pendant arm location allows 1) the patient bed to be variably positioned to take advantage of visitation or window views, and 2) optimal configuration or movement of specialized diagnostic or circulatory support devices. Unique to the pediatric CICU environment was the need for a radiant warmer in each room (to prevent hypothermia in neonates who have difficulty maintaining temperature homeostasis) and surgical lighting to facilitate aforementioned bedside procedures. These items were also mounted on the adjustable pendant arms for maximum utility and flexibility. The radiant warmer functions on a safety timer to avoid excessive heat exposure.

The third zone, closest to the interior hallway, is the caretaker with access to the patient, ventilation and monitoring systems, medications and IV infusion pumps, and all other equipment necessary for patient care. This zone includes a wall-mounted, flat-screen computer with retractable, flip-

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down keyboard for charting and note/laboratory data acquisition, as well as a cart for disposable supplies. A sink with an electronic motion sensor (to avoid touching of bacterially colonized surfaces after hands are cleaned) and associated soap dispensers are strategically located at the entry/exit to encourage proper visitor and caretaker hand-washing.

Patient/family privacy and shading needs are addressed in the CICU, despite the use of breakaway glass doors to the interior hallway and large exterior windows. Integral blinds lay between layers of glass and may be adjusted to provide full blocking of light or interior views. Not only does this approach obviate the need for interior curtains, but it also has the added infection control advantage of the blinds not being susceptible to dust build-up.

View through patient zone to staff zone

The traditional concept of patient to room orientation with respect to a headwall becomes challenged with the current availability of ceiling mounted medical service booms that bring medical gas, utilities, and other clinical service options right to the bedside. Is the concept of a code-required minimum width headwall still justified if ceiling booms are used? With a variety of manufacturers offering this technology along with the inherent swing capability and rotational latitude the booms offer, the concept of a flexible patient to room orientation is now more possible that ever. With this being the case, we must now ask what value the flexible orientation could bring to the clinical patient care or the patient care environment.

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A few attributes for consideration are:
· More manageable medical equipment
· Increased available clean floor area with less congestion
· Variable observational sight lines and patient view options

CMCD medical and technical staff researched four proprietary brands of ceiling booms and toured a hospital-based installation of each manufacturer. They analyzed all of the features of the booms, associated peripheral components, and range of motion/ease of operation and control. Afterward a consensus summary and selection criteria was generated to determine the product that most fit their needs. The following data is a highlighted summary of selection criteria compiled by CMCD's Stephen Brownfield for final selection of the ceiling boom manufacturer:

After evaluating several medical utility/equipment management booms, we have come to a decision on the product that will best meet the needs of both our clinicians and the patients. The other vendors, without exception, fall short of fulfilling these requirements. Below are the system requirements as well as the "KILL" points for each of the manufacturers we evaluated.

System requirements (all elements were evaluated on their ability to meet specific requirements with attention to patient safety and flexibility):

Medical gas-ability to deliver all required medical gases
Monitoring and ventilation systems-effectively and efficiently support's both systems (both physically and functionally)
Infusion systems-flexible in supporting these devices, provides the appropriate power, easily transfers devices for patient movement
Provide heating devices-ability to utilize CMCD standard without altering functionality
Surgical grade lighting-lighting of such a grade to be used for surgical type procedures

Manufacturer "A": This system has several qualities that make it clinically unacceptable. This system has no positive locking system; the basic design severely limits its usage and functionality.

Manufacturer "B": Like Manufacturer A, there is no positive locking system, which we find clinically unacceptable. Additionally, the system presented is a ceiling mounted rail system, which will severely reduce the flexibility for the room, thus contradicting this key design element.

Manufacturer "C": These systems were not found to be clinically unacceptable. However, due to several design elements, namely the lack of a transport trolley system, Manufacturer C was excluded as well.

Manufacturer "D": Was deemed clinically acceptable because it met all our specific requirements and had a unique solution to the infusion device transport concern (i.e., the transport trolley).

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It is our recommendation that the contract be awarded to Manufacturer D.

Clinical Planning Issues Affected by Existing and Future Building Systems
Early in the development of the project, all agreed to design efficiently and effectively with the inherited existing condition limitations. As typical with addition and renovation work, most of the design impacting limitations dealt with existing conditions that were typically related to one of four building systems:

· Structure-existing concrete roof beams prohibited certain locations from being used for plumbing drains or sewer lines. The cost of coring through structural reinforced concrete is expensive and runs the risk of damaging the structure
· Life safety-fire stairs and existing exiting systems were in place and needed to be incorporated/expanded
· Vertical transportation-elevator core was already established on the floors below
· M/E/P-shafts and risers would also need to be established as prototypical locations

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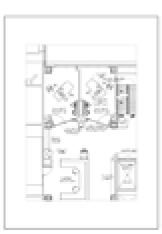
The space available for the CICU consists of two floors that will serve as vertical circulation, staff support for the adjacent bed tower in the next phase of construction, and a future bed tower. The central core is dedicated to future elevator shafts. The exit stair stacks with an existing stair on the perimeter. MEP shafts flank the elevators and the stairs. The floor-to-floor height on the second level is generous; however, the third level floor-to-floor height is only 12'-0". X-bracing was added to reinforce the existing concrete structural system. The CICU design accommodates the vertical expansion by limiting the coring of existing beams to maintain structural integrity. In addition, soft types of support are located in the future elevator hoistway, MEP does not cross the hoistway, and MEP shafts are sized for future needs. All of these accommodations limit the number of patient rooms, which fit the perimeter and shift clinical support away from the future central elevator hoistway.

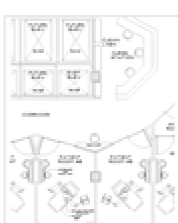
Sightlines are resolved by creating two nurse stations and are supported by three levels of observation. A central physio-monitoring station occurs at each staff station. The sub-charting station shared by pairs of rooms partakes of both in-room patient monitoring and direct patient observation. The most immediate observation occurs in the room with a patient charting position within the staff zone and in direct view of the patient.

Consistency of room design departs from the traditional staff orientation: Gone are the fixed headwalls that demonstrate and reinforce the desire for uniform patient room configuration in the staff zone. The team re-examined the relationships between the proximity of the patient and the sub-charting location; the staff handwash sink and patient toilet unit proximity to the room entry; relationship between plumbing chases and existing structure; and equipment clearances for movement of the patient bed. See Figures 3, 4, and 5 for the variations on these themes.

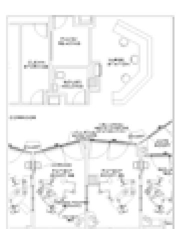
In Figure 5, the consensus plan, the patient head and monitor were located on the sub-charting wall; the patient toilet unit was eliminated since patients able to leave the bed have progressed enough to move to the acute care floors; the handwash sink was located inside the patient room next to the sub-charting station to allow clear movement of equipment in and out of the room; and the plumbing chases were moved away from the beam lines. Flexibility of bed location is allowed by ceiling mounted headwall booms, but the ceiling height required for the booms eliminated the possibility of patient rooms on the third level.



Early schematic



Middle schematic



Final design

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design option design option development option

In the upcoming vertical expansion, the critical care room is being designed to allow easy conversion to an acute care room. Therefore, the handwash sink location and family support areas will stack with the acute care plan on the floors below. The most significant change in the upcoming suite patient room is the elimination of the sub-charting location and the addition of a doorway between patient rooms.

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Closing Thoughts

As medical technology continues to evolve and find its way into the patient care environment, the general issue of patient and family stress, and its associated impact on healing, must also be checked. Healthcare design trends today vacillate from a less technical appearing patient room with some concealment apparatus and residential type finishes, to a highly technical environment that puts function over form.

A preliminary sampling of focus group families in the CICU setting indicates that issues such as reputation for quality of care, comfort, service, safety, and wayfinding are crucial contributing factors in crafting a low stress environment. Initial perceptions are important, but patients and families' perceptions change over time. Often the high dependence on technology that develops during the progress of a patient's care actually creates some withdrawal anxieties among the family members when the patient is moved to step-down or acute care. They question the absence of medical technology in the less-than-critical environment.

A fully functional patient suite differs from the typical room mock-up in that it must respond to all aspects of healthcare architecture. Its value as an interim study is that it allows all of the members of the design team to experience all aspects of the design. Many, if not most, of the clinical staff involved in design decisions are not able to fully understand the impact of their decisions when described graphically. This interim phase of construction has served two important goals. It has relieved increased patient volumes and has allowed the entire team to better understand the impact of the design decisions.

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Figure 1
(20k)

Figure 2
(5k)

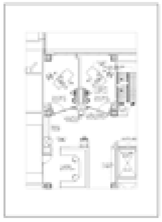

Figure 3
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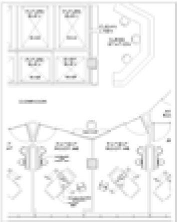

Figure 4
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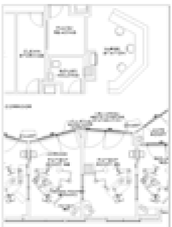

Figure 5
(5k)

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Figure 1: View through patient room to family zone

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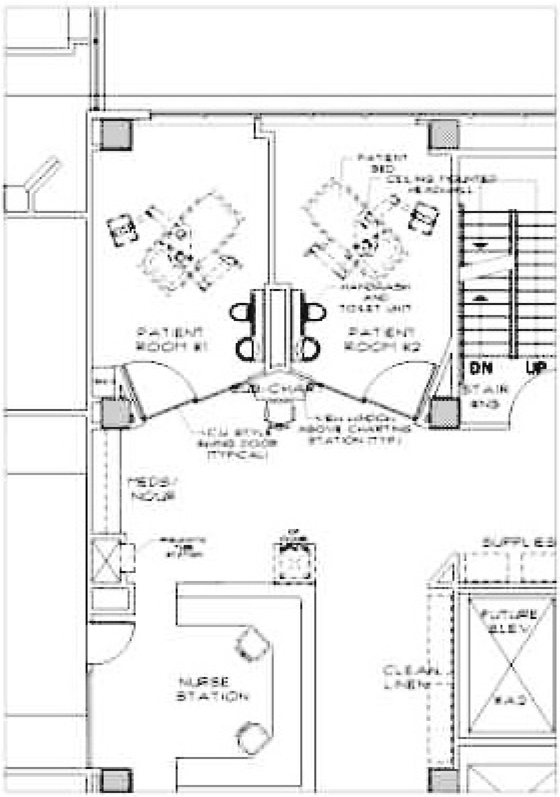

Early schematic design option

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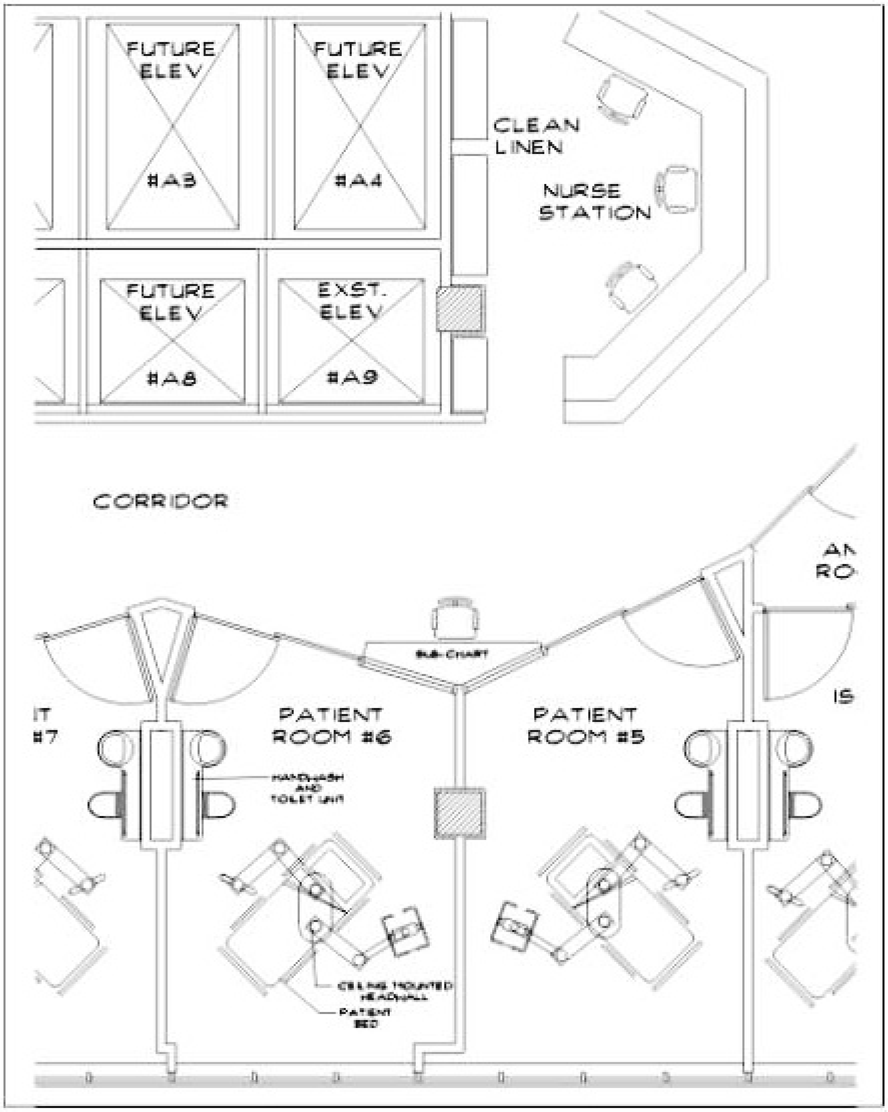

Middle schematic design option

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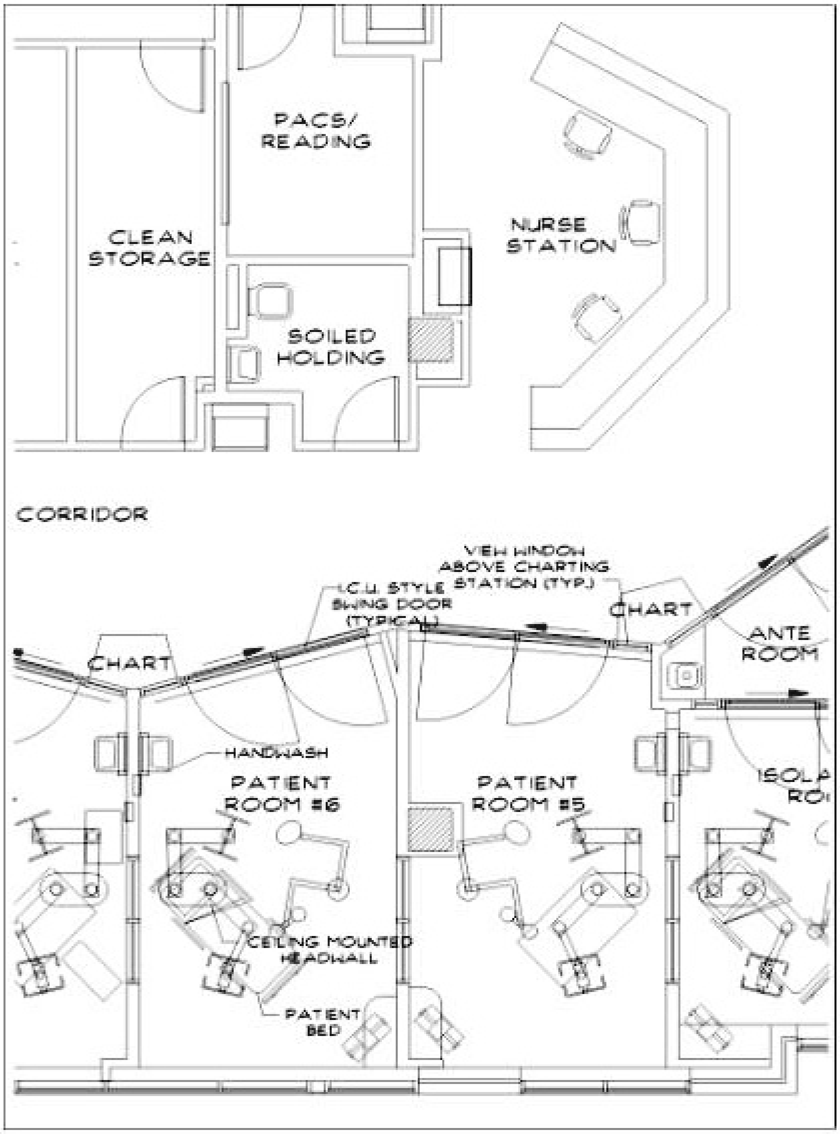

Final design development option

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